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First Record of Two Marine Planktonic Ciliates *Rimostrombidium orientale* and *R. veniliae* (Ciliophora: Choreotrichida) from Korea

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ABSTRACT

Two marine planktonic ciliates are investigated by using protargol impregnated techniques. These are *Rimostrombidium orientale* Song and Bradbury, 1998 and *R. veniliae* Montagnes and Taylor, 1994. Both species are new to Korean waters.

Key words: marine ciliates, *Rimostrombidium*, *Rimostrombidium veniliae*, *Rimostrombidium orientale*

INTRODUCTION

Planktonic ciliates are the important components of pelagic food web and comprise of very diverse groups (Montagnes and Lynn, 1991; Porter et al., 1985). Previous researches on planktonic ciliates were focused on loricate tintinnids, which are conspicuous in morphology, and easy to observe (Montagnes and Lynn, 1991; Leakey et al., 1993). Compared with loricate ciliates, planktonic aloricate ciliates (mostly oligotrichs) are usually more abundant than tintinnids (Beers and Stewart, 1967; Beers, 1969a, b, 1970; Beers et al., 1971; Johansen, 1976; Smetaček, 1981). Thus, it is important to know the information on aloricate ciliates for understanding planktonic ciliate community.

However, species information on aloricate ciliates is still sparse due to the difficulties of species identification. Thus, the ecological work has been restricted due to the insufficient information of species. To better understanding the role of ciliates in microbial food webs, accurate identification of naked ciliate species is required. In Korea, most of aloricate ciliate communities are still unknown. We here report the new records of two marine planktonic ciliates *Rimostrombidium orientale* Song and Bradbury, 1998 and *R. veniliae* Montagnes and Taylor, 1994.

Petz and Foissner (1992) defined the spiraling of the somatic kineties at the posterior pole as the distinguished characteristics of *Strobilidium*. Also they transferred *Strobilidium* lacking a caudal spiral to *Rimostrombidium* Jankowski, 1987. *Rimostombidium* have slightly spiralling somatic ciliary rows not extending to the posterior end of the cell. Sixteen species belonging to the genus *Rimostrombidium* have been reported by Petz and Foissner (1992), Montagnes and Taylor (1994), Petz et al. (1995), and Song and Bradbury (1998).

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MATERIALS AND METHODS

Sampling was conducted in Incheon coastal area (126° 27′-126° 37′E, 37° 17′-37° 35′N) from January to December of 2000. Water samples were collected with Niskin bottles and transferred to laboratory with a 1 *l* polyethylene bottle, then fixed with Bouin's fluid (Coats and Heinbokel, 1982; Montagnes and Lynn, 1987) and concentrated by settling for subsample. Seawater temperature ranged from 1.1 to 29.0°C and salinity ranged from 15.1 to 32.6 psu during the sampling period.

Quantitative protargol staining (QPS) by Montagnes and Lynn (1987) was used to reveal the ciliary and nuclear pattern. We adopted the terminology and classification schemes established by Song et al. (1999) and Lynn and Small (2000), respectively.

RESULTS AND DISCUSSION

Order Choreotrichida Small and Lynn, 1985
Suborder Strobilidiina Small and Lynn, 1985
Family Strobilidiidae Kahl in Doflein and Reichenow, 1929
Genus *Rimostrombidium* Jankowski, 1978

***Rimostrombidium orientale* Song and Bradbury, 1998 (Fig. 1, Table 1)**

Rimostrombidium orientale Song and Bradbury, 1998, pp. 781-784.

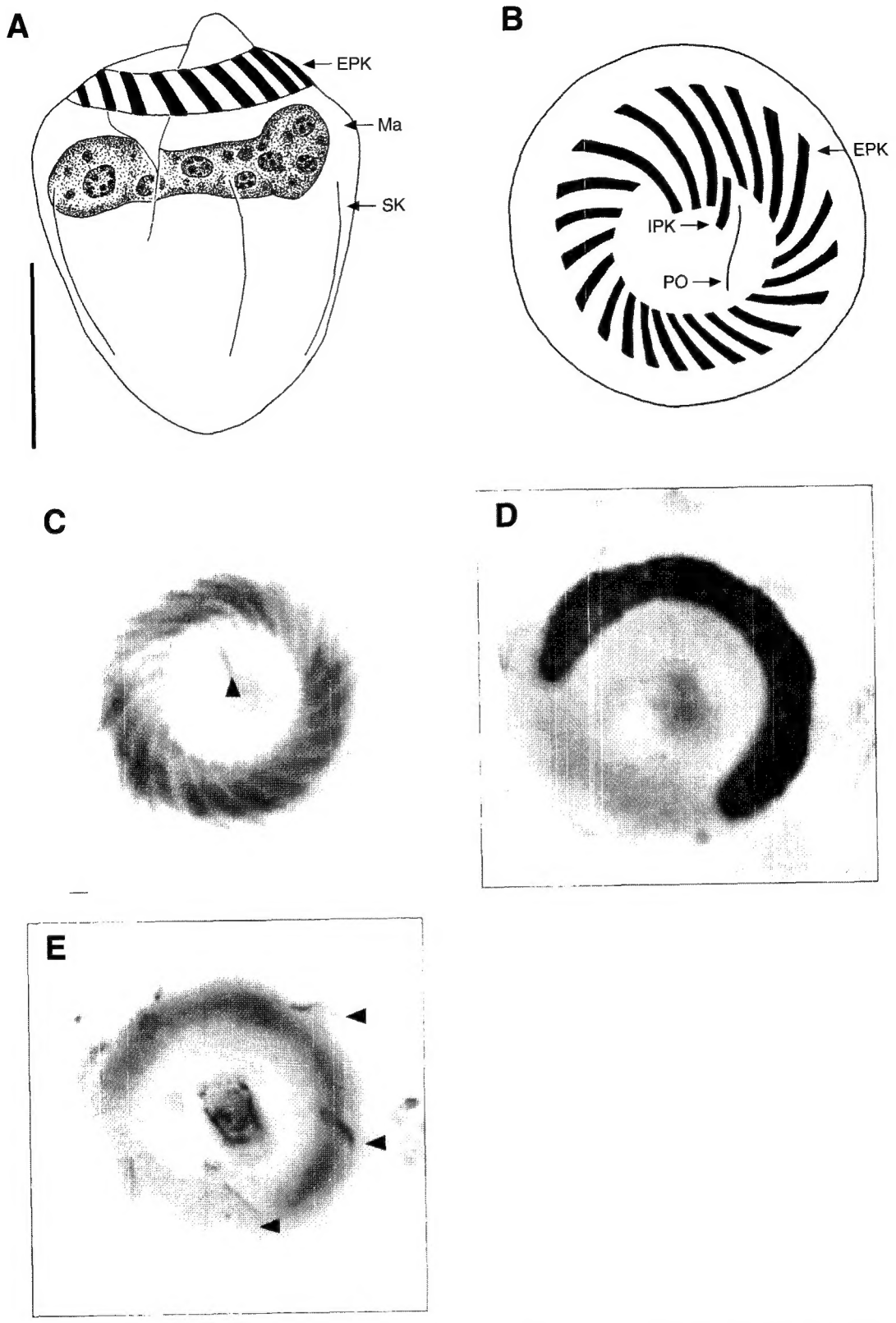

Fig. 1. *Rimostrombidium orientale*. A, Side view; B, Frontal view; C, Frontal view indicating position of paroral kinety; D, Macronucleus; E, Posterior view indicating somatic kineties. EPK, external polykinetid; IPK, internal polykinetid, Ma, macronucleus; PO, paroral kinety; SK, somatic kineties. Scale bar=10 μm.

Description. Body slightly ovoid, cross section circular, size 20-47 × 15-28 μm, peristomial margin with frontal protrusion. External polykinetid zone (EPZ) surrounding anterior end, composed of 19-25 polykinetids, each with three rows of cilia, about 15 μm long, three external polykinetids extend into oral cavity (Fig. 1). Internal polykinetid zone (IPZ) composed of 1-2 polykinetids (Fig. 1). Slightly curved paroral kinety (PO) lies through cytostome. Six somatic kineties of closely spaced kinetosomes, with 1 μm cilia directed to the right. Somatic kineties equally spaced around cell. Macronucleus C-shaped, horizontally located.

Remarks. This species was first reported by Song and Bradbury (1998). Compared with the original species, our specimens are slightly larger than those in original description (Table 2). But except the body size, all features of original species are in accord with present species.

Rimostrombidium orientale is similar to *R. sphaericum* Lynn and Montagnes, 1988, *R. undinum* Martin and Montagnes, 1993 and *R. veniliae* Montagnes and Taylor, 1994. *R. sphaericum* has larger body size (59 vs. 20-47 μm), more external polykinetids (24-30 vs. 19-25) and a higher number of somatic kineties (9-11 vs. 6) than the present species (Table 2). *R. undinum* has 4-6 internal polykinetids, while *R. orientale* has 1-2 internal polykinetids, and differs in the absence of frontal protrusion, different body shape, different length and appearance of somatic kineties. *R. veniliae* is similar to *R. orientale* in the number of external polykinetids but are strongly spiral (bases of polykinetids are more elongated bowl-shaped without frontal protrusion vs. spherical with a noticeable frontal protrusion), and has different number of somatic kineties (10 vs. 6).

Table 1. Morphometric characterization of *Rimostrombidium orientale* (upper) and *R. veniliae* (under). Data are based on protargol impregnated specimens

Character	Min	Max	Mean	STD	N
Cell length	22	47	28.5	12.5	5
	25	40	32.5	6.5	5
Cell width	15	28	20.2	5.1	5
	31	40	36.2	3.8	5
Number of external polykinetids	19	25	22.3	2.5	5
	20	23	21.5	1.7	5
Number of internal polykinetids	1	2	1.3	0.6	5
	1	2	1.5	0.6	5
Number of somatic kineties	6	6	6.0	0.0	5
	10	10	10.0	0.0	5
Number of paroral kineties	1	1	1	0.0	5
	1	1	1	0.0	5

Measurements in μm. Max, maximum value; Min, minimum value; STD, standard deviation; N, number of specimen

Rimostrombidium veniliae (Montagnes and Taylor, 1994) Petz et al., 1995 (Fig. 2, Table 1)

Strobilidium veniliae Montagnes and Taylor, 1994, pp. 576-578.

Rimostrombidium veniliae Petz et al., 1995, p. 144.

Description. Body subspherical shaped, cross section circular, 25-40 × 31-40 μm. External polykinetid zone (EPZ) surrounding anterior end, composed of 20-23 polykinetids with cilia 25-30 μm long. Inner portion of each external polykinetids begins with four ciliated kinetosomes with 1-2 μm long cilia, directed inward. Internal polykinetid zone (IPZ) composed of 1-2 polykinetids. Paroral kinety (PO) parallel to internal polykinetids (Fig. 2B, C). Ten somatic kineties consisting of closely spaced kinetosomes, 1-2 μm long cilia directed to the right. Somatic kinety equally spaced around cell, extend from 3 μm below oral area to near

Table 2. Morphological comparison of related *Rimostrombidium* species. Data are based on protargol impregnated specimens. Measurement in μm. EPK, external polykinetid; IPK, internal polykinetid; SK, somatic kineties

	R. multinucleatum	*R. orientale*	*R. orientale*	*R. sphaericum*	*R. undinum*	*R. veniliae*	*R. veniliae*
Cell length	30 (26-32)	22-30	20-47	59 (40-70)	21 (16-29)	24 (14-40)	30-40
* (in vivo)	†	* (25-35)	†	†	†	†	†
Cell width	31 (25-35)	†	15-28	49 (40-60)	17 (15-23)	25 (15-45)	31-40
* (in vivo)	†	* (20-30)	†	†	†	†	†
No. of EPK	18 (18-20)	20-23	19-25	26 (24-30)	23 (21-24)	22-23	20-23
Length of EPK	†	†	†	†	†	35 (3-35)	†
No. of IPK	†	1	1-2	†	5 (4-6)	1-2	1-2
No. of SK	5	6	6	10 (9-11)	6	10 (6-12)	10
References	Lynn and Montagnes (1998)	Song and Bradbury (1998)	This study	Lynn and Montagnes (1998)	Martin and Montagnes (1993)	Montagnes and Taylor (1994)	This study

†: Data not available

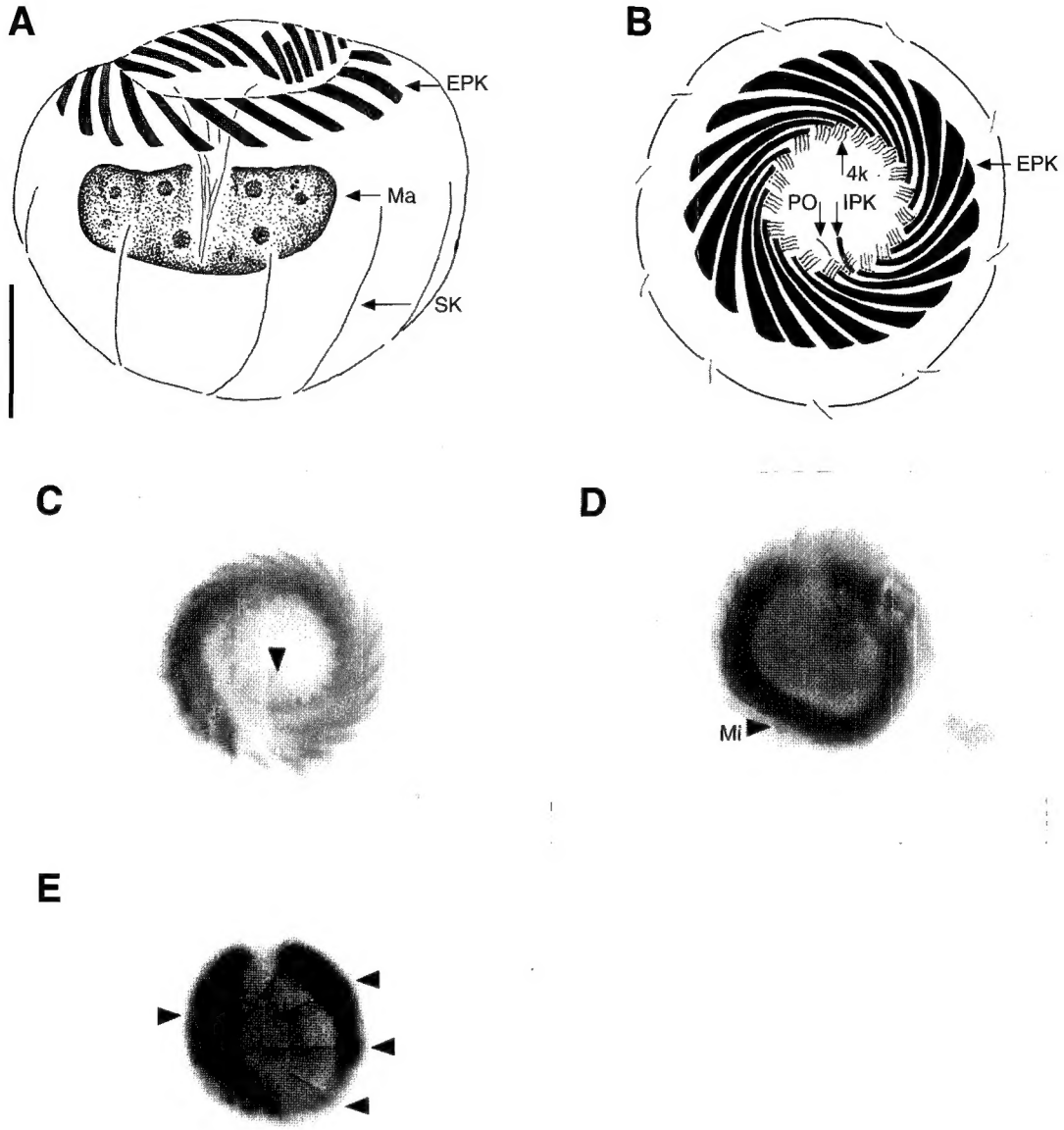

Fig. 2. *Rimostrobidium veniliae*. A, Side view; B, Frontal view; C, Frontal view indicating portion of paroral kinety; D, Macronucleus and micronucleus; E, Posterior view indicating ten somatic kineties. 4k, four ciliate kinetosomes internal to each external polykinetid; EPK, external polykinetid; IPK, internal polykinetid; Ma, macronucleus; Mi, micronuclus; PO, paroral kinety; SK, somatic kineties. Scale bar=10 μm.

posterior region. Macronucleus C-shaped, horizontally located. Micronucleus lies in a depression of the macronucleus.

Remarks. This species was first reported by Montagnes and Taylor (1994) and transferred to *Rimostrombidium* by Petz et al. (1995). Compared with the original species, present species is almost coincident with the original specimens, except the body size (Table 2).

Rimostrombidium veniliae is similar to following species: *Pelagostrobildium neptuni* Montagnes and Taylor, 1994; *P. spiralis* Leegaard, 1915; *Rimostrombidium sphaericum* Lynn and Montagnes, 1988; *R. multinucleatum* Lynn and Montagnes, 1988; *R. undinum* Martin and Montagnes, 1993. However, these species are different from *R. veniliae*

in infraciliature structures. *P. neptuni* and *P. spiralis* differ in asymmetrical distributions of somatic kineties and many internal polykinetids (Montagnes and Taylor, 1994). *R. sphaericum* has no internal polykinetids. *R. multinucleatum* differs in the number of somatic kineties and macronuclei. *R. undinum* has six somatic kineties, 4-6 internal polykinetids (Table 2).

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